Space Weather Technical Forecast

Issued on Monday 3 March 2025 at 00:09 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of G1/G2 late Tuesday 04 March and through UTC midweek. Active 24-hour electron fluence becoming Likely beforehand.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity measured at GOES16 and 18 has been Low, with a peak flare of C2.9 at 02/0938UTC from a small, but rapidly developing sunspot region in the southeast quadrant.

The solar disc now features around seven sunspot regions, with AR4010 and AR4008 having faded to plage as well as some minor unnumbered regions. There are perhaps five main sunspot regions now populating the disc, and the majority of these have shown some increase in complexity in the past UTC day. In the northwest, AR4006 fragmented into numerous small sunspots and pores to take on a Bxi/Beta appearance. In the southwest, AR4007 showed areal growth, spreading and consolidation to become a Dai/Beta. In the north centre, AR4009 showed some fading in its trailing group but strong growth in a more northern set of spots that may yet constitute a new group in their own right, becoming a Dsi/Beta by the period's end. Finally, in the east, AR4011 and AR4012 both saw emergence of spots, areal growth and a spreading trend, with the latter in particular greatly increasing in size in the period.

No Earth-directed Coronal Mass Ejections (CMEs) were identified in available coronagraph imagery in the period. The only notable CME on coronagraphs in the late UTC morning was determined to be high latitude (far northwest) and far-sided.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE at L1, are indicative of a continuing waning connection to a strong positive polarity coronal hole fast wind (CH19/+).

Solar wind speeds have been on a declining trend, gradually waning from strong levels near 600km/s to end the 24 hours at Slightly Elevated levels near 450km/s. The solar wind density was within typical single-figures ppcc throughout. The IMF was at Background levels on a slightly rising trend to a peak of 7nT, while the north-south component showed a gradual rotation from near -2 to near +5nT over much of the UTC day. The phi angle was largely positive (away from the Sun).

The net result of the above solar wind measures was provisionally Quiet to Unsettled geomagnetic activity, peaking in the 06-09UTC interval at Kp '3o'.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was at Background levels.

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High energy electron flux saw a relative rise in its diurnal oscillation relative to earlier in the UTC weekend, with a peak of High flux and 1460pfu reached at 02/1715UTC. The 24-hour fluence was below the Active threshold (1e8 integrated pfu), but on a rising trend, recording 4.57e7 integrated pfu at 02/2359UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity carries a daily Chance of becoming Moderate, with isolated M-class flares. This may rise slightly into the start of the new UTC week as regions potentially return over the eastern limb.

Solar Wind / Geomagnetic Activity: A CME from the 01/1730UTC filament eruption from the southeast disc may affect Earth as a glancing blow around 04/1900UTC. This is the only CME in the forecast.

Otherwise, fast wind influence from CH19/+ is expected to continue to wane, with Slightly Elevated winds soon easing to Background prior to any CME arrival. This is the only coronal hole in the forecast.

Geomagnetic activity is expected to be mostly Quiet initially until later Tuesday 04 March, whereupon the aforementioned CME may bring a Chance of G1 to end this UTC day and on through midweek UTC. Activity should lessen once again later in the UTC working week.

Energetic Particles / Solar Radiation: High energy proton flux should remain at Background levels.

High energy electron flux saw a rise relative to the preceding 24-hour period is likely to increase during this period. The associated 24-hour fluence also has the potential to rise, Likely breaching the Active (1e8 integrated pfu) threshold by Tuesday 04 March. The 01/1730UTC CME reduces confidence after midweek UTC, with perhaps a Chance of Active fluence surviving should the CME miss or prove limited in effects.

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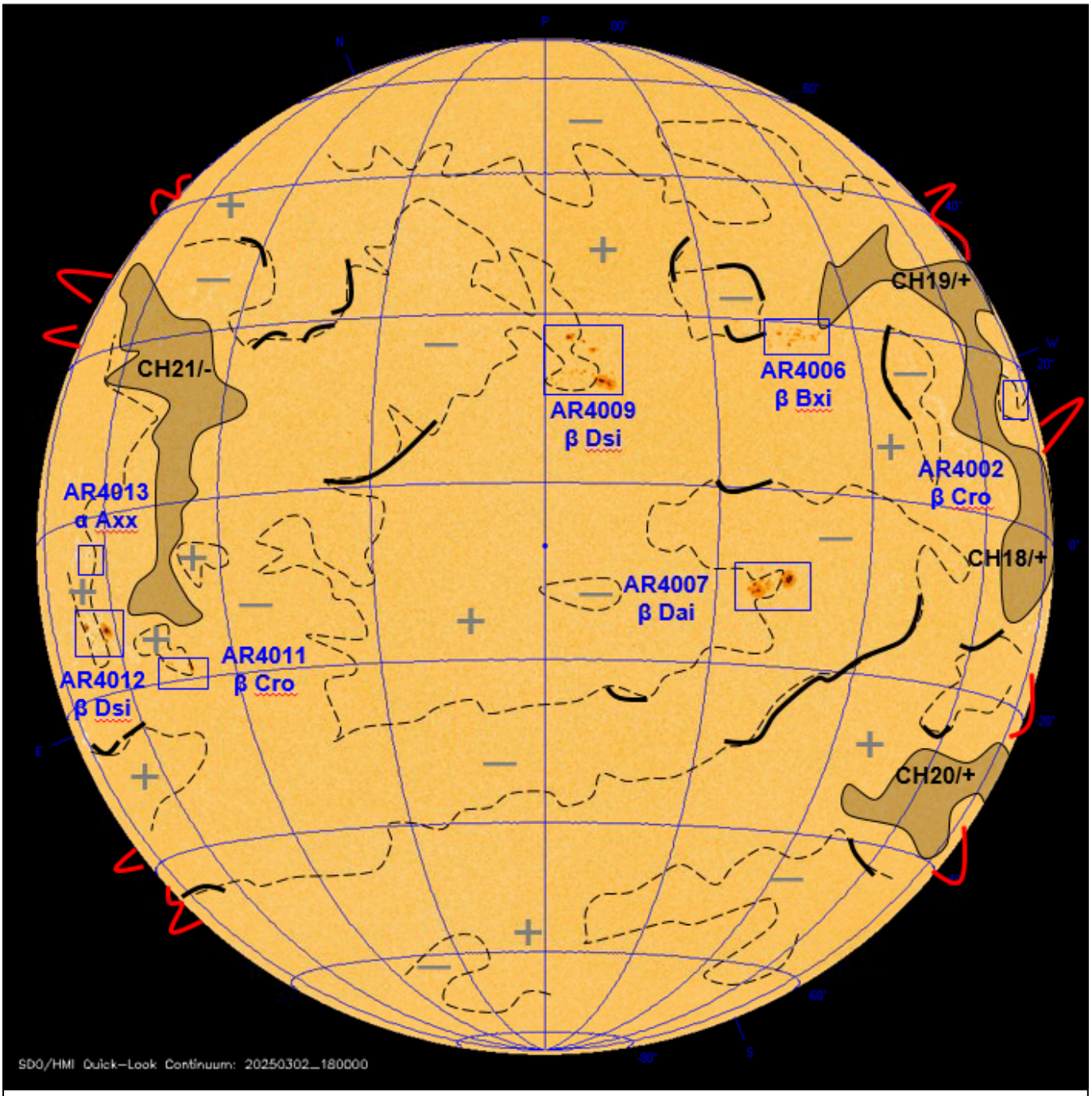
Figure 1: MOSWOC Solar Synoptic Map, valid 02/1800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

A CME from the 01/1730UTC filament eruption from the southeast disc may affect Earth as a glancing blow around 04/1900UTC, although it appears the majority of the ejecta is south and east of the Sun-Earth line. This is the only CME in the forecast.

In addition to the above, the otherwise ongoing fast wind influence from CH19/+ is expected to continue to wane, with currently Slightly Elevated winds further falling to Background in the coming 24 hours or so. No further coronal holes are expected to feature in the forecast period.

Geomagnetic activity is now Likely to be mostly Quiet until later on Tuesday 04 March, whereupon the aforementioned CME brings a Chance of G1 (Kp5) to end this UTC day and on through midweek UTC. There is a Slight Chance this may reach G2 (Kp6) given the nature of the eruption, should it arrive early in the evening with unfavourable polarity. Because of the forecast arrival time coming late in the 24-hour UTC day, much of the G1 risk is actually post-dated into Wednesday 05 March in the magnetic cloud, although this may not fully develop due to the glancing incidence expected.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	20	30	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
02/0154UTC	Partial?	Filament eruption	SE quadrant	550	Late UTC day Tuesday 04 March, around 04/1900UTC.	Potentially protracted but marginal effects on passage given glancing incidence.

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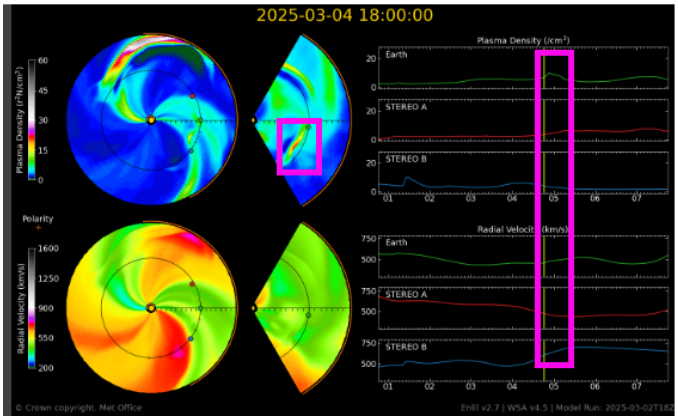
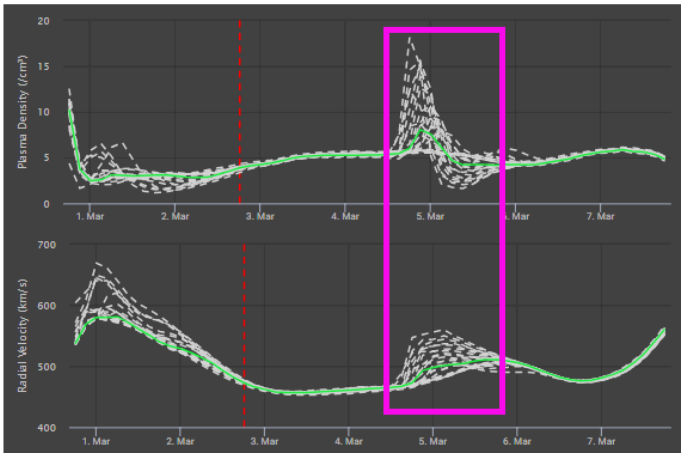
Figure 2: Latest MOSWOC Enlil run and ensemble (badge time 02/1800UTC) paused at the 1AU crossing time of the 01/1730UTC CME. This is expected to mostly pass below and behind the Sun-Earth line, although recent runs have proven quite volatile in the extents of hits shown in the ensembles, perhaps proving that the CME is right on the limits of being geoeffective.





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Radio Blackouts - X-Ray Flares

The complexity of the current Earth-facing disc is currently relatively low, but many of the larger groups saw growth and proliferation of spots in the UTC day of Sunday 02 March. The past 24 hours have seen a rise and fall in terms of overall numbers of sunspot regions, with these casualties for the most part simple Zurich Axx groups and of little import for the forecast. The main regions to watch are perhaps AR4006 in the northwest given its weekend habit of launching jet-like emissions north of the Sun-Earth line, although none has yet resulted in any obviously Earth-directed component. The other main active regions on the facing side are perhaps AR4009 in the northwest and AR4007 in the southwest, which both saw some areal growth in the past 24 hours.

In terms of the evolution of the forecast, no significant regions leave the disc in the period, while there are up to three returning Carrington locations of regions due over the eastern limb into the new UTC week. One of these was responsible for the peak flare Saturday 01 March, and may be the dominant consideration into the new week.

Overall, there is a slightly rising Chance of M-class flares in the period, near the raw value for the disc as it stands.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	30	40	40	40
Very Active	R3-R5 (X Class)	No	1	1	1	1

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Figure 3: The past UTC week in GOES16 X-ray flux and Penticton 10.7cm flux, with both showing a strong declining trend as the Earth-facing disc has simplified.

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Solar Radiation Storms (High Energy Protons)

GOES18 high energy (>10MeV) proton flux is at Background, and expected to remain at this level. There is a Slight Chance of enhancement to S1 given any significant eruption from the sunspot regions currently on the Earth-facing disc, very gradually increasing through midweek UTC as some of the more complex regions reach better-connecting parts of the disc (i.e. the westernmost third).

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	2	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

The high energy electron flux (>2MeV), as observed at GOES16, has seen the magnitude of its diurnal oscillation rise over the past UTC weekend, reaching High flux for a period in the past UTC day. This was due to the recent charging of the outer Van Allen Belt from the fast wind enhancement from CH18/+ and/or CH19/+. This rising trend is expected to continue through until Tuesday 04 March, in a reaction to the recent Strong solar wind. High flux being maintained at GEO becomes far less certain through midweek UTC as a result of possible influence of the 01/1730UTC filament CME, which may cause electron redistribution and falls of flux at GEO.

The associated 24-hour fluence should see a rising trend into the new UTC working week, Likely rising above the Active level late Monday 03 or perhaps into Tuesday 04 March. MOSWOC REFM's recent thoughts in a strong surge to perhaps reach Very Active fleunce has eroded in the past 24 hours, such that more recent data points are much more marginal as to whether Active fluence is even reached. This is before any fluence trend is polluted by potential CME influence and confidence is overall reduced, but perhaps still odds on for exceedence before any CME arrives. The chances of Active fluence persisting through midweek then rely on any CME missing Earth, else a very gradual erosion of GEO electron counts might be expected in the coronal hole-free forecast period.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ 1×10^{8}**	No	50	60	50	30
Very Active	**≥ 2 MeV ≥ 1×10^{9}**	No	1	1	1	1

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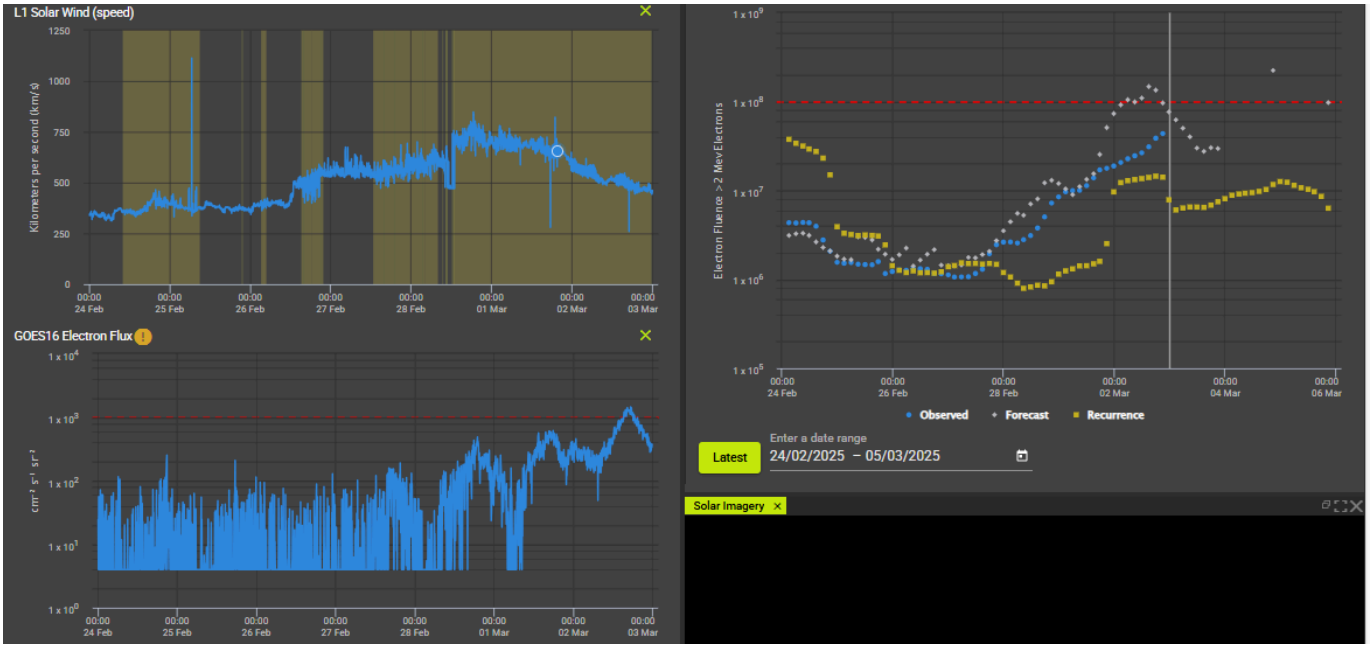
Figure 4: Clockwise from top left: L1 solar wind speed (ACE in yellow shading) showing recent CH18/19 fast wind reaching 750km/s and now waning; MOSWOC REFM forecast (grey), and observed 24-hour fluence (blue), showing rising but more cautious forecast revision in the past 24 hours; and GOES16 high energy electron flux, showing day-on-day rise in response to the waning fast wind from CH18/19.



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